Mansoura Univerdity
Faculty of Engineering
Dept. of Electronics & Electrical Comm.

Electromagnetic fields
Final Exam
Time allowed: 3 Hours

Answer the following questions; assuming any missing data.

1) a- A uniform line charge of ρl = 2 nC/m lies along the y axis, while uniform surface charge densities of + 0.1 and - 0.1 nC/m2 exist on the planes z = 3 m and z = - 4 m, respectively. Find E at the point P(1,-7,2). At which point is E the negative of the field at P?

   b- Given the electric field $E = (4x-2y)\,a_x - (2x+4y)\,a_y$, Find the equation of the stream line that pass through the point P (2,3,-4)

2) a- State Gauss's law
   b- A uniform volume charge density of $80\mu C/m^3$ is present throughout the region 8 mm <r<10 mm. Let ρ_v =0 for 0<r<8 mm.
      1- Find the total charge inside the spherical surface r=10 mm,
      2- Find D_r at r=10 mm, and
      3- If there is no charge for r>10 mm, find D_r at r=20 mm.

3) Within the cylindrical region $\rho \leq 5$ m, the electric flux density is given as $4\rho^2\,a_\rho\ C/m^2$.
      1- What is the volume charge density at ρ = 2m?
      2- How much electric flux leaves the cylinder $\rho = 2, -5 \leq z \leq 5$?
      3- How much charge is contained within this cylinder?

4) Given $E = -x\,a_x + y\,a_y$,
      1- Find the work involved in moving a unit positive charge on a circular arc, the circle centered at the origin, from x=a to $x=y=a/(2)^{1/2}$
      2- Verify that the work done in moving the charge around the full circle from x=a is zero.

5) Two current filaments are parallel to the z-axis. One passes through (0,0.5,0) and carries 100 mA in the a_z direction; the other passes through (0,-0.5,0) and carries 100 mA in the $-a_z$ direction. Plot H_x versus y, 0<y<2 for points on the y-axis.

6) Three Infinitely long parallel filaments each carry 50 A in the a_z direction. If the filaments lie in plane x=0 with 2 cm spacing between wires, find the vector force per meter on each filament.